THE EFFECT OF A REFERENCE POSTURE ON THE RELATIONSHIP BETWEEN RELAXED CALCANEAL STANDING MEASUREMENT AND FRONTAL PLANE REARFOOT MOTION DURING WALKING IN PATELLOFEMORAL PAIN SYNDROME SUBJECTS

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INTRODUCTION

The choice of a reference posture used in angular motion calculations may play an important role in finding a relationship between the static posture and rearfoot frontal plane of motion in a clinical population such as patellofemoral pain syndrome (PFPS). By using the relaxed standing as a reference posture [1], a frontal plane deviation in the reference posture may mask any appearance of abnormal frontal plane rearfoot motion during walking. This study examined the relationship between rearfoot inversion/eversion during the stance phase of walking and the static relaxed standing measurement in females with PFPS and healthy controls and examined the influence of reference postures used when calculating these measures. Two reference postures were investigated: (1) Vertical Alignment between the rearfoot and the lower leg and (2) Relaxed Calcaneal Standing.

METHODS

Fourteen healthy and 13 females with PFPS were videoed barefoot during five walking trials using a four-camera (50Hz) motion analysis system. External markers attached to a tibia shell and the calcaneus measured peak inversion/eversion motion of the rearfoot relative to the tibia. Two reference postures were assessed: 1. Relaxed Calcaneal Standing posture and 2. Vertical Alignment i.e with the posterior calcaneus and lower leg vertically aligned. For Relaxed Calcaneal Standing reference posture, subjects stood relaxed in a self selected comfortable position. Vertical Alignment posture was achieved when the subjects elevated or lowered their medial longitudinal arch. While this posture was maintained the frontal plane alignment of the rearfoot relative to the tibia was recorded. For Vertical Alignment posture, to enable normalization of the study population to the same zero reference posture for inter-group comparison of the rearfoot relative to the tibia in the frontal plane, the vertical axis was rotated [2] through the individual's angle in the frontal plane previously recorded. All walking trial angles were calculated relative to both the Relaxed Calcaneal Standing and Vertical Alignment postures. Pearson's Correlation was used to investigate the relationship between the Relaxed Calcaneal Standing and stance phase peak inversion and eversion when using the two reference postures.

RESULTS AND DISCUSSION

When using the Relaxed Calcaneal Standing reference posture a significant correlation was found between static relaxed standing measurement and maximum eversion in the control group only (Table 1). When using the Vertical Alignment reference posture, significant correlation was found in PFPS only for both maximum eversion/inversion (Table 1). Thus, indicating that with a more everted posture during relaxed standing there is more eversion and less inversion during walking. As subjects in the control group did not demonstrate an increased calcaneal eversion during static relaxed standing measurement, it is unlikely that these subjects would demonstrate abnormal foot function during walking. A mathematical relationship is therefore unlikely to be found. The relationship between the rearfoot static clinical measurement and dynamic function of the rearfoot during walking therefore may be present in a clinical population rather than healthy control subjects.

CONCLUSIONS

As the Relaxed Calcaneal Standing reference posture may eliminate the inherent compensated foot during dynamic foot function, the use of neutral posture may be necessary. The positive relationship found in the PFPS group between dynamic angular measure and static relaxed standing based on a neutral reference posture indicated that PFPS subjects the clinical rearfoot measurement relaxed standing can be used to explain the pattern of rearfoot motion during walking.

REFERENCES

1. McPoil & Cornwall. JOSPT. **23**: 370-375, 1996.
2. Hunt & Smith. Clinical Biomechanics, **19**, 391-397, 2004

Table 1: The correlation between rearfoot static relaxed standing and rearfoot peak inversion/eversion (Mean±SD) when calculated using the two reference postures (Relaxed Calcaneal Standing and Vertical Alignment) for PFPS and control groups.

Reference posture	Relaxed Calcaneal Standing			Vertical Alignment		
	Mean±SD	R value	P value	Mean±SD	R value	P value
Control						
Inversion	12.8°±5.46°	-0.04	0.789	10.25°±6.11°	0.457	0.101
Eversion	2.8°±4.63°	-0.770	0.001*	5.41°±2.99°	-0.153	0.602
PFPS						
Inversion	13.14°±4.86°	0.135	0.661	5.57°±6.29°	0.643	0.018*
Eversion	4.21°±2.57°	0.119	0.698	11.64°±4.85°	0.768	0.002*

** Significant at p≤ 0.05*